

# 2020 VCE Applied Computing: Software Development examination report

## General comments

In 2020 the Victorian Curriculum and Assessment Authority produced an examination based on the *VCE Applied Computing: Software Development Adjusted Study Design for 2020 only*. The 2020 VCE Applied Computing: Software Development examination comprised three sections: Section A, with 20 multiple-choice questions (worth a total of 20 marks); Section B, with five short-answer questions (worth a total of 20 marks); and Section C, which was a case study with 14 questions (worth a total of 60 marks).

Section A was answered quite well by most students. In Sections B and C, some students found it difficult to demonstrate their theoretical knowledge or use subject-specific terminology correctly. The key weakness in many responses was a lack of detail and depth of understanding. Students are encouraged to consider the command word of the question (for example, 'describe', 'explain' or 'outline'), the number of marks and the number of lines provided as a guide to the detail and depth of the required response.

In Section C, some students found it difficult to apply their knowledge to the case study.

During the examination, students are encouraged to:

- endeavour to use correct technical terminology
- discuss all options when asked to justify a choice or compare one option with another
- respond to key instructional terms, such as 'state', 'explain' and 'describe'
- re-read each question and their response to ensure that the question has been answered
- remove the case study insert from the question and answer book, and refer to it when completing Section C
- read the case study and questions carefully, and underline or highlight key words
- demonstrate knowledge of the subject and apply that knowledge to the case study; general responses often result in low or no marks, but knowledgeable, clear and appropriate responses receive high marks.

## Specific information

Student responses reproduced in this report have not been corrected for grammar, spelling or factual information.

This report provides answers or an indication of what answers may have included. Unless specifically stated these are not intended to be exemplary or complete responses.

The statistics in this report may be subject to rounding resulting in a total more or less than 100 per cent.

## Section A – Multiple-choice questions

The following table indicates the percentage of students who chose each option. The correct answer is indicated by shading.

| Question | % A | % B | % C | % D | Comment  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
|----------|-----|-----|-----|-----|--|---|---|---|---|---|--|---|---|---|---|---|----|---|---|---|---|---|----|
| 1        | 6   | 48  | 1   | 45  | Many students selected floating point; however, the most appropriate data type to reflect a millimetre is integer.   |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 2        | 4   | 26  | 19  | 51  | Many selected that the most suitable technique for documenting opportunity is as an SRS; however, prior to this step, writing a problem statement is essential.  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 3        | 34  | 6   | 17  | 43  | D is the correct answer as it is the only valid constraint. A is incorrect as the way the current system is being used is not a constraint.  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 4        | 29  | 45  | 11  | 15  | A linear search (B) is the only search technique that can be used on an unsorted list. There is no such search as a quick search (A).  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 5        | 1   | 2   | 96  | 1   |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 6        | 24  | 9   | 40  | 28  | Many students selected interviews; however, the most appropriate technique to collect data about an existing information system without time constraints is observations.  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 7        | 17  | 61  | 8   | 14  |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 8        | 1   | 19  | 64  | 15  |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 9        | 17  | 7   | 48  | 28  | C is correct as in order to generate different design ideas, brainstorming and mind maps would be required. Each other option involves using a design tool or tasks taken during the development stage.  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 10       | 20  | 75  | 2   | 4   |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 11       | 50  | 23  | 3   | 24  | A is correct as disposal involves permanently deleting data from a repository including copies made in archives and backups.   |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 12       | 13  | 16  | 56  | 15  |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 13       | 75  | 8   | 8   | 9   |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 14       | 11  | 9   | 30  | 50  | <p>The tracing table shows why D is the correct answer.</p> <table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>7</td> <td>1</td> <td></td> </tr> <tr> <td>6</td> <td>2</td> <td>7</td> </tr> <tr> <td>5</td> <td>3</td> <td>12</td> </tr> <tr> <td>4</td> <td>4</td> <td>5</td> </tr> <tr> <td>3</td> <td>5</td> <td>16</td> </tr> </tbody> </table> | A | B | C | 7 | 1 |  | 6 | 2 | 7 | 5 | 3 | 12 | 4 | 4 | 5 | 3 | 5 | 16 |
| A        | B   | C   |     |     |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 7        | 1   |     |     |     |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 6        | 2   | 7   |     |     |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 5        | 3   | 12  |     |     |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 4        | 4   | 5   |     |     |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |
| 3        | 5   | 16  |     |     |  |   |   |   |   |   |  |   |   |   |   |   |    |   |   |   |   |   |    |

| Question | % A | % B | % C | % D | Comment  |
|----------|-----|-----|-----|-----|--|
| 15       | 3   | 18  | 76  | 2   |  |
| 16       | 92  | 2   | 4   | 1   |  |
| 17       | 32  | 7   | 52  | 10  | Antivirus software (C) would be the most sensible option as it would stop malware from being installed. A firewall would only detect packets of data leaving a network after the malware had been installed. |
| 18       | 1   | 10  | 7   | 82  |  |
| 19       | 16  | 3   | 8   | 73  |  |
| 20       | 29  | 6   | 60  | 5   |  |

## Section B – Short-answer questions

### Question 1a.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 18 | 52 | 30 | 1.1     |

Most students were able to explain that a naming convention provides consistency in the naming of variables in software solutions. Some students further explained that by using a naming convention, the effort needed to read and understand the source code during both development and maintenance was lessened.

### Question 1b.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 66 | 14 | 20 | 0.5     |

Few students suggested applying a naming convention to the data dictionary by changing the variable names Var1 and Var2 to more suitable names. Marks were awarded for changing Var1 to inputName and Var2 to lenName. Appropriate equivalent variable names were also accepted.

### Question 2a.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 30 | 51 | 19 | 0.9     |

Some students were able to explain that pseudocode allows the programmer to express the logic and design of an algorithm in structured English. Some students also added that by writing pseudocode, a programmer can identify errors in logic before commencing development.

When answering questions relating to pseudocode, it is important that students remember that pseudocode is language independent.

The following is an example of a high-scoring response.

*It allows Camilla to have a more detailed idea of what the code will look like, helping her identify any errors in the real code faster. It also allows other developers to understand the program more easily if Camilla chooses to get help.*

## Question 2b.

| Marks | 0  | 1 | 2  | 3  | 4  | 5  | 6  |   | Average |
|-------|----|---|----|----|----|----|----|---|---------|
| %     | 20 | 8 | 10 | 10 | 12 | 15 | 16 | 9 | 3.4     |

The following is an example of a possible response to this question. Some variations were also accepted. The missing answers are indicated by shading.

```
secretNum ← random(1,100)
guessCounter ← 0
Print "Enter the secret number"
guessNum ← input value from keyboard
Repeat 15 times or until guessNum = secretNum
    Print "Enter the secret number"
    guessNum ← input value from keyboard
    If guessNum > secretNum then
        Print "Too high"
        guessCounter ← guessCounter + 1
    elseif guessNum < secretNum then
        Print "Too low"
        guessCounter ← guessCounter + 1
    End If
End Repeat
print guessCounter
if guessCounter < 15 (then)
    print "Well done! You got the secret number quickly"
else
    print "It took too long"
endif
```

A number of students were unable to complete the missing lines from the algorithm using pseudocode. Common errors included:

- the use of incorrect operators (<, <=, >, >=)
- the incorrect use of the equals sign (= instead of □)
- forgetting to end a control block of code with 'end if'
- printing the wrong message for a condition
- not indenting code.

When answering questions using pseudocode, it is important for students to remember that they are writing machine independent code. Students would benefit from exposure to a range of sample algorithms throughout the year. In addition, a range of formative assessments on developing appropriate pseudocode may assist in further developing knowledge and skills.

### Question 3

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 72 | 13 | 14 | 0.4     |

Few students were able to outline that a function is a module of code that returns a value, compared with a procedure that is a module of code that does not return a value. Therefore, as a calculation returns a value, a function should be used to perform a calculation.

Common misconceptions included the following:

- A function requires less code to run than a procedure.
- A function takes input in the form of a parameter whereas a procedure does not.
- Functions are called often so they are therefore more appropriate than procedures (overlooking that procedures can also be called many times).
- A function is faster than a procedure.

### Question 4a.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 50 | 26 | 24 | 0.7     |

Students listed a range of procedures and techniques for the handling and managing of files and data. For example:

- regular backups
- regular archiving and disposal of files
- naming conventions of files and folders.

These included but were not limited to archiving, backing up, disposing of files and data and security.

Some students incorrectly listed software auditing and testing strategies. Many also incorrectly listed techniques for searching and sorting or treated this question as an extension of the previous question on the differences between procedures and functions.

It is important that students are able to distinguish between file and data management procedures and a technique or function that is used to retrieve data when programming.

### Question 4b.

| Marks | 0  | 1 | 2  | 3  | Average |
|-------|----|---|----|----|---------|
| %     | 60 | 5 | 17 | 18 | 0.9     |

A range of explanations was accepted depending on the procedures listed in Question 4a. Students who scored highly described the procedure and related it back to data and file management.

The following is an example of a high-scoring response.

*Procedure: Archival*

*Explanation: Amir can apply the procedure of archival to reduce the amount of data that is kept in active storage. This is done by moving data off of active storage and onto another system such as tape storage so the data is cheaper to maintain.*

## Section C – Case study

### Question 1

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 58 | 42 | 0.4     |

Some students correctly identified that a goal of the FRIDGESMART app was to provide efficient ordering of HOMEMADE products. Many students found it difficult to clearly define an information system goal in the context of the case study. Some students incorrectly listed organisational goals such as 'to improve profit'. Others listed non-functional requirements relating to security and user-friendliness.

### Question 2

| Marks | 0  | 1  | 2  | 3  | 4 | Average |
|-------|----|----|----|----|---|---------|
| %     | 26 | 22 | 30 | 17 | 6 | 1.5     |

Many students correctly described the agile development model as being both an iterative and incremental model with a focus on process adaptability, customer satisfaction and rapid delivery. Some students also outlined that the agile development model is completed in short iterative 'sprints' (or builds). Many students were able to describe the waterfall development model as a logical progression of steps taken throughout the PSM.

However, few students provided a justification for the choice of the agile model over the waterfall model in relation to the case study. They were not able to outline either an advantage of the agile model or a limitation of the waterfall model that made the agile model more suitable.

There were some misconceptions that the agile model allows the development team to move from one stage within a sprint to another stage, as opposed to completing multiple sprints in an iterative nature.

A possible example of a justification for the choice of agile over waterfall could be:

The iterative nature of the agile model would allow for the effectiveness of the app to be assessed at the end of each iteration so that feedback could be incorporated into the next iteration.

The following is an example of a high-scoring response because it described the agile model and provided a comparison to the waterfall model and justification as to why the agile model was more suitable.

*Using agile, John can be more flexible to the needs of his clients as agile works in sprints, meaning that the problem solving methodology is completed every cycle. He can get new information about the solution requirements of FRIDGESMART and can add any changes based on the evaluation stage of the last sprint. As waterfall is a more linear development model, it doesn't give John any opportunity to get feedback during the development process and thus wouldn't let him satisfy the want of the FRIDGESMART company as well as the agile model will. Also, as John is an experienced developer, he would have the skill necessary to implement the agile development model.*

### Question 3a.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 83 | 17 | 0.2     |

Very few students were able to successfully identify the tasks on the critical path. Either of the following two versions of the critical path were accepted.

- 11, 12, 13, 14, 15, 17, 18
- 10, 11, 12, 13, 14, 15, 17, 18, 19

### Question 3b.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 57 | 27 | 16 | 0.6     |

Few students were able to correctly explain that delaying the interviews by one extra day would have no impact on the project's timeline because the task 'Conduct data collection 1: Interview' does not fall on the critical path.

### Question 4a.

| Marks | 0  | 1  | 2 | Average |
|-------|----|----|---|---------|
| %     | 65 | 28 | 7 | 0.4     |

Few students were able to outline that the purpose of the SRS is to document the needs of the stakeholders and indicate how the system is expected to perform. Instead of considering the overall purpose of the SRS, many incorrectly listed its components, such as functional and non-functional requirements, scope or constraints.

### Question 4b.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 47 | 32 | 21 | 0.7     |

Students were asked to identify two sections of the SRS and to describe each section. A number of students successfully identified two of the following three sections as listed in the study design:

- scope – the part of project planning that involves determining and documenting a list of specific project goals, deliverables, tasks, cost and deadlines
- constraints – inclusive of design constraints are physical requirements, performance requirements, software development standards, and software quality assurance standards
- system and technical requirements – the system and technical issues that must be considered to successfully complete a project; these are aspects such as performance, reliability and availability that your project must meet in order to proceed.

## Question 5

| Marks | 0 | 1  | 2  | 3  | 4  | Average |
|-------|---|----|----|----|----|---------|
| %     | 7 | 12 | 19 | 29 | 33 | 2.7     |

The majority of students completed the data flow diagram, but many did not identify all four labels correctly:

- A Customer
- B Order confirmation notification
- C Customer order
- D HOMEMADE database or HOMEMADE or Order file

## Question 6

| Marks | 0  | 1  | 2  | 3  | 4 | Average |
|-------|----|----|----|----|---|---------|
| %     | 10 | 33 | 35 | 14 | 8 | 1.8     |

Many students were awarded marks for suggesting that the FRIDGESMART app was supposed to operate and work as intended for different types of users with different levels of experience. Many were awarded marks for discussing the importance of testing the FRIDGESMART app under different conditions and environments. Some correctly suggested that as part of the agile model, different users can find different faults in the solution, which could then be fixed within the next sprint or iteration of the agile model.

When a question requests **two** reasons, it is important that students provide two distinct reasons. Many repeated the same reason (e.g. 'a range of customer feedback') as an explanation for two of the types of users. Students who scored highly gave two distinct reasons that related to the information provided in the question and in the case study.

The following is an example of a high-scoring response.

- *Gives a better view of the user experience when gathered from a multitude of demographics as they will respond differently to each other and prevent the software from being only relevant to a very precise target audience.*
- *Better for finding bugs and errors as different types of customers will use different parts of the software more, and thus by getting a wide variety of people to use the software, all parts of it will be tested more thoroughly.*

## Question 7

| Marks | 0 | 1 | 2  | 3  | 4  | Average |
|-------|---|---|----|----|----|---------|
| %     | 8 | 4 | 21 | 32 | 35 | 2.8     |

This question was answered well by most students. The most successful student responses correctly selected Modified design 2 and justified this choice as follows:

- The menu options in Modified design 2 are more appropriately sized than in Modified design 1.
- The purpose of the buttons in Modified design 2 is clearly communicated through the use of images and pictures compared with Modified design 1.
- The user interface in Modified design 2 is more balanced due to the alignment and size of its components in comparison to Modified design 1.



Many responses did not contain any discussion about Modified design 1; students must always remember to provide a comparison between alternatives when justifying a selection.

## Question 8a.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 26 | 56 | 18 | 0.9     |

| Item name | Data type      | Description   |
|-----------|----------------|---|
| Barcode   | String         | product barcode for an item<br>format is up to 14 digits, including spaces                  |
| TimeOut   | Floating point | timestamp of when an item was last removed from the refrigerator<br>format is YYMMDD.HHMMSS |

Many students incorrectly identified the barcode as an integer, which is not possible given that the description of the item states that it must include spaces. When identifying a data type for TimeOut, many students referred to data types that are not listed in the study design.

## Question 8b.

| Marks | 0  | 1  | 2  | 3  | 4 | Average |
|-------|----|----|----|----|---|---------|
| %     | 41 | 24 | 20 | 11 | 3 | 1.1     |

Many students correctly identified that XML was the most appropriate file type for use when transferring data because XML is extensible in its structure and is made up of elements, sub-elements and attributes. It can therefore accommodate different products and items as part of a customer order being sent from the FRIDGESMART app to HOMEMADE.

Some students also correctly commented that a limitation of CSV is that it would place constraints on the way data is organised within a file, as a predefined number of values must be separated by commas. When justifying a choice, students must always remember to provide a limitation of the alternative.

Some students incorrectly stated that XML was more appropriate than CSV because it could be used on different operating systems (suggesting that CSV could not, which is incorrect). Some students also incorrectly stated that XML is more secure than CSV.

## Question 9a.

| Marks | 0  | 1  | 2  | 3 | 4 | Average |
|-------|----|----|----|---|---|---------|
| %     | 50 | 19 | 13 | 9 | 9 | 1.1     |

| Test   | Expected result      | Actual result        |
|--|----------------------|----------------------|
| Item.TimeOut = 12.53*<br>Item.Returned = FALSE | item.Ordered ← FALSE | item.Ordered ← FALSE |
| Item.TimeOut = 11.09**<br>item.Returned =TRUE  | item.Ordered ← FALSE | item.Ordered ← TRUE  |
| item.TimeOut = 11.09**<br>item.Returned =FALSE | item.Ordered ← TRUE  | item.Ordered ← TRUE  |
| item.TimeOut = 11.10<br>item.Returned =TRUE    | item.Ordered ← FALSE | item.Ordered ← FALSE |
| item.TimeOut = 11.10<br>item.Returned = FALSE  | item.Ordered ← FALSE | item.Ordered ← FALSE |

\*a value representing a time after 11.10 and before 15.10

\*\*a value representing a time before 11.10

Students are reminded that it is important to conduct boundary testing above, on and below a numeric value. As item.Returned is a Boolean value, boundary testing should be conducted both when item.Returned is TRUE and FALSE.

## Question 9b.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 71 | 29 | 0.3     |

Some students identified that the line of pseudocode producing the error was:

**If** item.Returned = FALSE **Or** item.Ordered = FALSE **Then**

Currently, an item can be ordered if it has not been returned **or** it has not been ordered (meaning an item that has been returned could be reordered, and an item that has been ordered can be reordered). This is because an item should only be reordered if it has not been returned and it has not been ordered.

Students must be able to work through an algorithm by reading its pseudocode and testing data for a range of scenarios.

## Question 9c.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 69 | 31 | 0.3     |

Some students were able to rewrite the pseudocode so that it produced the correct output by changing **Or** to **And**.

**If** item.Returned = FALSE **And** item.Ordered = FALSE **Then**

## Question 9d.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 86 | 14 | 0.1     |

A few students were able to identify that the data structure 'Orders' was an Associative array (hash table and dictionary were also accepted). Some students answered that 'Orders' was a one-dimensional array, which is incorrect as item. The barcode was being used as a key to represent an associated value, as opposed to being used as an index in a one-dimensional array. Other students incorrectly identified the 'Orders' data structure as a two-dimensional array and yet others identified it as a list. Students are expected to be familiar with different types of data structures, including associative arrays, one-dimensional arrays and records.

Some students incorrectly listed data types when answering this question. It is important that students understand the difference between a data type, which holds one value, and a data structure, which organises a collection of different values and types.

## Question 10a.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 40 | 60 | 0.6     |

Most students correctly identified 1234 as the barcode found in the first iteration of the binary search.

## Question 10b.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 55 | 45 | 0.4     |

Some students were able to identify that the barcode found in the second iteration of the binary search was 1005. This is because a binary search uses a divide and conquer strategy, so the search space of the second iteration includes the numbers up to but not including 1234.

## Question 10c.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 68 | 32 | 0.3     |

Some students correctly answered that it would take four iterations of a binary search to identify that barcode 1050 was not in the list. It is important for students to practise manually working through the searching and sorting algorithms listed in the study design with sample testing data.

## Question 11

| Marks | 0  | 1  | 2  | 3 | Average |
|-------|----|----|----|---|---------|
| %     | 60 | 20 | 14 | 6 | 0.7     |

Students were awarded marks for explaining that a selection sort is easier to program than a quick sort, and that when sorting small lists of data, such as items in a customer order, the benefit to efficiency from using a quick sort would be insignificant. Some correctly stated that because the list of orders would already be sorted, fewer swaps would be needed when using a selection sort.

Some students incorrectly stated that the quick sort could not be used to sort items alphabetically and therefore the selection sort was more appropriate.

## Question 12a.

| Marks | 0  | 1  | Average |
|-------|----|----|---------|
| %     | 56 | 44 | 0.4     |

Many students identified that the legislation that applies to the constant voice monitoring scenario was the *Privacy Act 1988*. Students should be reminded to include the correct year of the legislation.

Some students incorrectly identified the *Privacy and Data Protection Act 2014*, which only relates to data held by the Victorian public sector.

## Question 12b.

| Marks | 0  | 1  | 2  | 3 | Average |
|-------|----|----|----|---|---------|
| %     | 45 | 32 | 16 | 7 | 0.9     |

Some students were able to state correctly that users of the FRIDGESMART app need to give permission for their data to be collected or, alternatively, be given the option of anonymity. An additional appropriate statement was that *HOMEMADE* are required to store data securely and ensure that data is both accurate and relevant. Students also commented that *FRIDGESMART* had an obligation to know where their data was being stored.

## Question 12c.

| Marks | 0  | 1  | 2 | Average |
|-------|----|----|---|---------|
| %     | 84 | 10 | 6 | 0.2     |

Successful student responses contained an explanation that it is unethical for a programmer to write code to decide what items a customer should not purchase. Some students justified this by outlining that although one member of a household may be allergic to avocado, the purchase may be for another family member.

Many students incorrectly stated that the ethical concern related to a breach of the *Privacy Act 1988*. It is important that students understand the distinction between a scenario where legislation has been breached and a separate unethical scenario where a law is not being broken.

## Question 13a.

| Marks | 0  | 1  | 2  | 3 | Average |
|-------|----|----|----|---|---------|
| %     | 34 | 27 | 30 | 9 | 1.1     |

Most students were able to describe a man-in-the-middle attack as a form of cyber attack where a malicious attacker inserts themselves into an electronic conversation between two parties. Most students were able to explain that a man-in-the-middle attack would result in data being intercepted while being transmitted between the customer and FRIDGESMART. Very few students explained that a man-in-the-middle attack results in a third-party impersonating either the customer or FRIDGESMART and altering data being sent between them.

## Question 13b.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 16 | 45 | 39 | 1.2     |

This question was generally answered well. Most students stated that risks relating to a man-in-the-middle attack included the following:

- customers' personal and financial data could be stolen or used fraudulently
- damage to FRIDGESMART's reputation resulting in customer loss.

## Question 13c.

| Marks | 0  | 1  | 2  | Average |
|-------|----|----|----|---------|
| %     | 33 | 37 | 30 | 1.0     |

Some students were able to explain how an appropriate software security control could protect the software and the company's data. A range of software security controls were accepted including the use of encryption, firewalls, antivirus software, monitoring network traffic, software updates, user authentication and passwords.

Many students either listed the control only or provided limited detail about how the control works in relation to the case study.

## Question 14

| Marks | 0  | 1  | 2  | 3  | 4 | Average |
|-------|----|----|----|----|---|---------|
| %     | 31 | 21 | 30 | 10 | 9 | 1.4     |

The most successful student responses identified a risk management strategy and explained how the strategy would reduce security vulnerabilities in the context of software development practices and the case study.

Risk management strategies included but were not limited to:

- software auditing and software security testing
- identification of weaknesses and risk of exploitation such as vulnerability and penetration testing, white hat hacking
- compliance checking in relation to the use of third-party software
- version control.

Good responses included a discussion of software security controls (such as firewall, backup and user authentication); however, students are reminded that they must always relate their responses back to the identification of security risks.

The following examples of high-scoring responses identify a strategy and explain how the strategy reduces a security vulnerability.

- *Risk management strategy 1: Perform code audits before using external code. This ensures third-party code does not contain malicious insert or vulnerabilities, as a trusted developer would set the secure code before permitting its use.*
- *Risk management strategy 2: Run a security audit of the system including penetration testers. This will highlight vulnerabilities in the FRIDGESMART system and allow them to address it before a potential hacker exploits them.*